21. CONVENTIONAL FACILITIES

Architectural Design

The preferred site of the proposed femtosecond x-ray facility is in the *Old Town* area of Berkeley Lab in close proximity to the Advanced Light Source (ALS). The conventional facilities will consist of a two story building of approximately 125,000 gross square feet, and two separate free standing structures – a Cryogenic Plant, that will provide liquid helium for cooling of the accelerator, and an Utility Center, that will house heavy equipment for mechanical and electrical building systems support.

The high bay first floor of approximately 91,000 gross square feet will house the machine consisting of injector, linear accelerator, magnetic arcs, and production beam array of undulators and bend magnets, producing multiple beamlines. In addition to the machine, the first floor will provide experimental area, assembly areas, and laser rooms. There will be a continuous circulation pathway along the perimeter of the building to facilitate emergency exiting and day-to-day circulation between the functional areas. The structural bay housing the accelerator machine will be equipped with a 10-ton crane to facilitate installation and maintenance of the accelerator components. The experimental area will be served a by a monorail following the outline of experimental stations.

The second floor will house the control room, and a mixture of user labs consisting of wet laboratories, dry laboratories, and semi-clean rooms. Adjacent to laboratory areas will be offices, conference rooms, and a core of support facilities including cold rooms, dark rooms, equipment rooms, and similar research support spaces. Because of the extremely tight footprint, the mechanical and electrical equipment room will be also located on this level. Great care will be taken to isolate the electrical a mechanical equipment to minimize the vibration and acoustical impact. The structural design will provide for future expansion of the second floor.

The building design is taking advantage of the sloped topography of the site. The building will be accessible from Segre road and from an upper roadway circling the existing historically significant grove of redwood and pine trees. The main lobby, entered from the upper road, will be located on a mid-level with an elevator and stair connection to both first and second floors. A small lobby with a stair and an elevator will be provided on the opposite side of the building accessed from Segre Road and adjacent to truck access for staging of scientific equipment.

The exterior finish of low maintenance, factory preformed and painted, metal siding and clear glass with low emissivity coating will be compatible and complementary to the ALS complex. The roof will be a single sheet roofing membrane system with heat reflective coating to reduce solar gain. Metallic screens will conceal rooftop mounted mechanical exhaust equipment. An enclosed pedestrian bridge will link the building with ALS to facilitate cross-disciplinary collaboration of users in both facilities.

The femtosecond x-ray source project will make every effort to deliver an environmentally responsible design, construction, and operation. Its environmental impact will be reduced through sensitive site development; control of southern and western solar loads by means of blinds, sunshades, and recessed windows; water and energy conservation; and environmentally responsible building materials.

The building will be protected by a sprinkler system connected to the LBNL fire alarm system. Smoke detection and other detection systems will be provided where required. The building will be designed in conformance with requirements for group 'B' occupancy as defined by the California Building Code (CBC), Type II fire resistive construction, and seismic safety and fire safety code requirements. The building will comply with disabled accessibility requirements in accordance with the Americans with Disabilities Act (ADA).

The project is sited in conformance with the LBNL Site Development Plan. The project site is currently occupied by several old buildings used by the ALS, Accelerator and Fusion Research Division (AFRD), Engineering, EH&S, Earth Sciences Division (ESD), and Facilities for research and other activities. These activities will be relocated.

Structural Design

Structural design shall account for all loads to which earth retaining systems and the building structure may be subjected including static, live, wind, seismic, etc. The design will comply with the requirements of the California Building Code (CBC) and *LBNL's Lateral Force Design Criteria.*

The first story of the building will be cast-in-place reinforced concrete slab-on-grade with tied back reinforced concrete retaining walls on the east, northeast and southeast sides. The west bay of the first story will contain cast-in-place concrete shielding structures at the beamline bends and be serviced by a top riding ten (10) ton crane. The upper floor and roof will be concrete slabs on metal deck supported by structural steel floor joists spanning between structural steel jack trusses supported by long span structural steel trusses and steel columns. In the transverse direction, the building will be a moment resisting frame and, in the longitudinal direction, various structural framing systems, such as eccentrically braced frames, concentrically braced frames and moment resisting frames, will be compared in the Title I design stage to determine the most suitable and cost effective system. The foundation system of the western portion of the building, including the shielding structures, will be drilled piers with reinforced concrete pier caps interconnected by tie beams. The foundation system of the eastern portion of the building will be isolated footings founded on bedrock and interconnected by tie beams.

Roofs shall be designed for a minimum mechanical equipment load of 50 lb/sq ft or the actual weight of the mechanical equipment, whichever is greater. The elevated floor will be designed for a 125 psf live load.

Nonstructural building elements and the mechanical and electrical systems will be designed to accommodate calculated displacements due to lateral forces from wind or seismic forces.

Mechanical Design

<u>Heating, Ventilation and Air Conditioning System</u>

The experimental floor and the second floor laboratories and offices will be heated or cooled with tempered air to maintain inside design temperatures 76°F ± 2° F in summer and 72°F ± 2° F in winter. Precise temperature control at 25°C ± 0.5°C (77°F ± 0.9°F) will be maintained in shielding tunnels and laser rooms. Humidity control is not expected to be required. The minimum ventilation rate will be 1 cfm/ft^2.

Air supply air handling units (AHU) will be housed in the second floor mechanical room. Exhaust fans will be mounted on the roof of the building within a screened area. The chillers and boilers will be located in the Utility Center. Chilled and heating hot water will be piped from the Utility Center to the AHU to provide pre-cooling and pre-heating. Final building heating will be provided by individual re-heat VAV boxes located throughout the building. Each unit will be provided with a dedicated temperature sensor to control re-heating and airflow from each individual VAV unit.

Process Piping

Mechanical utilities will include domestic cold and hot water (DC/HW), industrial cold and hot water (IC/HW), chilled water (CWS/R), low conductivity water (LCWS/R), compressed air (CA), vacuum (VA), fire sprinkler supply (FSS), sanitary sewer (SS), and helium (He) for cryogenic plant. The utilities on the main floor will be run in the trenches recessed in the concrete floor and terminate at valve stations at fixed locations compatible with accelerator assemblies or locations compatible with user needs. Liquid nitrogen will be provided by the cryogenic plant and will be piped or distributed in dewers to experimental stations and laboratories. Deionized water will be distributed through the second floor laboratories and polishing stations will be provided at points of use.

The following underground piping systems will require modifications and additions due to construction: low-conductivity water supply (LCWS), low-conductivity water return (LCWR), compressed air (CA), fire sprinkler supply (FSS), Sanitary sewer (SS), storm drain (SD), high-pressure city water (HPCW), high-pressure natural gas (HPNG), treated water supply (TRWS), treated water return (TRWR). Temporary mechanical and underground utility services will be provided to all adjacent buildings and operations that will be affected by the construction work.

Energy Conservation

A dynamic computer analysis technique will be used to evaluate energy conservation alternatives and life cycle costs, determine design energy consumption, and determine passive and active solar effects. Use of renewable energy systems will be evaluated and utilized when shown to be cost effective. The heating and ventilating systems will be controlled by the Johnson Controls, Metasys digital control system. The control system will have central monitoring. Control strategies will include temperature control, VFD-controlled fans, chillers, cooling tower fans, pumps, night set back (with override), economizer, and other applicable energy conservation strategies.

Electrical Design

Power requirements for the building are projected at approximately 10 MGW, with 2-3 MGW for cryogenic plant, 3 MGW for the accelerator and □4 MGW for user load. The building will be served by a dedicated electrical substation located on a separate pad in the vicinity of the Utility Center. The building will be served by 480/277 V and 208/120 V distribution systems with panelboards, branch circuit panels and step-down transformers located in dedicated electrical room.

An emergency generator will be located in the Utility Center. Emergency power loads will include emergency egress lighting, fume hood and helium exhaust, and back up for compressors and other research equipment. UPS will provide power for sensitive computer and control equipment through emergency generator start-up time.

Lighting controls will be zoned, automated, and integrated with the Energy Management and Control System. Enclosed offices will be individually switched and controlled with occupancy sensors. Where natural light is available, two-level switching or photocell controls will be utilized. Task and specialty lighting will be provided where required.

Emergency lighting will be provided in laboratories, corridors, stairwells and other public areas by connecting selected fixtures of the general lighting system to standby power circuits. Building exit signs and emergency egress lighting units will be provided with 90-minute backup battery packs and be connected to the standby power system.

The building will be equipped with telephone, communications, fiber-optic data circuits, paging and public address system, and building entry security system.

A complete building fire alarm system with extensions to the to the existing hill-wide LBNL fire alarm system will be provided.

Gross Area Summary

Building	
First Floor	91,000 SF
Second Floor	34,000 SF
Separate Structures:	
Cryogenic Plant	10,000 SF
Utility Center	4,000 SF
Switching Station	3,600 SF
First Floor (Gross SF)	
Experimental Area	16,000 SF
Assembly Area	7,000 SF
Laser Rooms (2 @ 250 SF)	500 SF
Machine	53,500 SF
Lobby and Circulation	14,000 SF
Second Floor (Net SF)	
Laboratories, Research Support	12,000 SF
Offices, Conference Rooms	
Lounge, Lobby, etc.	8,500 SF
Control Room	500 SF
Mechanical/Electrical Room	4,000 SF